

surface of the fixing frame 14 along right and left edges of the fixing frame 14. A chassis 16 is attached to the fixing frame 14 by the use of the vibration absorbing members 15.

[0028] The touch panel 11 is configured like a known touch panel.

[0029] The vibrating elements 12 are piezoelectric elements, actuators, or the like, and are connected to a vibration control signal line 17. The vibrating elements 12 are out of touch with the fixing frame 14. The vibrating elements 12 are expanded and contracted by a vibration control signal (or a driving voltage) supplied from an external controller (not shown) through the vibration control signal line 17. Expansion and contraction of the vibrating elements 12 elastically bend the touch panel 11 and cause flexural vibration to the touch panel 11.

[0030] The fixing cushions 13 have a long and narrow rectangular (parallelepiped) shape. The fixing cushions 13 are located parallel with each other to attach the touch panel 11 with the fixing frame 14. The fixing cushions 13 attach the touch panel 11 to the fixing frame 14 and serve as fulcrums (or nodes) in case where the touch panel 11 vibrates. The fixing cushions 13 have a thickness to leave a space for vibration of the touch panel 11 between the touch panel 11 and fixing frame 14. That is, the fixing cushions 13 are larger than the vibrating elements 12 in thickness. The fixing cushions 13 are fixed on the rear surface of the touch panel 11 along the edges, which are different from those along which the vibrating elements 12 are fixed, of the touch panel 11 by double faced adhesive tapes, adhesive material, or the like. The fixing cushions 13 are made of relatively hard material (having 40 degrees of hardness, for example) so as not to damp (or absorb) the vibration of the touch panel 11. Because the touch panel 11 is supported by the fixing cushions 13 at two parallel edges different from those on which the vibrating elements 12 are fixed, it is securely and stably supported by the fixing frame 14 through the fixing cushions 13. Furthermore, the touch panel 11 can vibrate effectively and greatly.

[0031] The fixing frame 14 is made of resin, for example, and has hardness so as not to be deformed by the vibration of the touch panel 11. The fixing cushions 13 fixed to the touch panel 11 are fixed on a front surface of the fixing frame 14 along the right and the left edges of the fixing frame 14 by double faced adhesive tapes, adhesive material, or the like.

[0032] The vibration absorbing members 15 are made of material (e.g. high density urethane foam, silicone rubber, elastomer) which is very soft in comparison with the fixing cushions 13. The vibration absorbing members 15 are fixed to the rear surface of the fixing frame 14 by double faced adhesive tapes, adhesive material, or the like, to be parallel with the fixing cushions 13. The vibration absorbing members 15 are further fixed to the front surface of the chassis 16 by double faced adhesive tapes, adhesive material, screws, or the like. The vibration absorbing members 15 absorb vibration of the fixing frame 14 caused by the vibration of the touch panel 11 and prevent or suppress transmission of the vibration from fixing frame 14 to the chassis 16.

[0033] The chassis 16 is made of resin, for example. In addition to the touch panel 11, electronic and/or electric circuit(s) or the like (not shown) is/are fixed to the chassis 16.

[0034] FIG. 3 shows a vibrating state of the touch panel 11. Upon supplying the vibration control signal (or AC voltage) to the vibration control signal line 17, the vibrating elements 12 are expanded and contracted in a lateral direction of FIG. 3 according to the vibration control signal. Because the touch panel 11 is supported by the fixing cushions 13 at the both edges thereof, the expansion and contraction of the vibrating elements 12 in the lateral direction bend the touch panel 11 elastically in an upward and downward direction as depicted by outline arrows in FIG. 3. Thus, the touch panel 11 vibrates like a beam which both ends thereof are fixed. That is, the flexural vibration is caused to the touch panel 11.

[0035] When the fixing cushions 13 are too hard, it is difficult for the touch panel 11 to vibrate. To the contrary, when the fixing cushions 13 are too soft, it absorbs the vibration of the touch panel 11. Therefore, the fixing cushions 13 need softness to allow the vibration of the touch panel 11 and hardness to hardly absorb the vibration of the touch panel 11. The fixing cushions 13 are made of material selected to meet the requirements mentioned above. It is preferable that high density micro cell polyurethane foam is used as the material of the fixing cushions 13. In particular, PORON HE-48 with 40-50 degrees of hardness or PORON H-48 with 40 degrees of hardness is more preferable as the material for the fixing cushions 13. The PORON is a brand name owned by ROGERS INOAC CORPORATION.

[0036] The vibration of the touch panel 11 vibrates the fixing frame 14 in upward and downward directions of FIG. 3. The vibration absorbing members 15 absorb the vibration of the fixing frame 14 to prevent or suppress transmission of the vibration from the fixing frame 14 to the chassis 16. Thus, the vibration absorbing members 15 suppress vibration of the electronic and/or electric circuit(s) fixed to the chassis 16. Therefore, reliability of the whole electronic apparatus is improved.

[0037] As mentioned above, in this embodiment, the vibrating elements 12 are provided along the upper and the lower edges which are long sides of the touch panel 11 while the fixing cushions 13 are provided along the right and the left edges which are short sides of the touch panel 11. However, the vibrating elements 12 may be provided along the right and the left edges which are short sides of the touch panel 11 while the fixing cushions 13 may be provided along the upper and the lower edges which are long sides of the touch panel 11. In this case, the vibration absorbing members 15 is disposed between the fixing frame 14 and the chassis 16 along the upper and the lower edges of the fixing frame 14 to be parallel with the fixing cushions 13.

[0038] Furthermore, it is unnecessary that the vibrating elements 12 stretch from one ends of the upper and the lower (or the right and the left) edges to the other ends of the touch panel 11. The vibrating elements 12 may be provided, for example, as illustrated in FIGS. 4A and 4B. That is, one of the vibrating elements 12 may be provided at the right hand side of the upper/lower edge while the other may be provided at the left hand side of the lower/upper edge. In addition, the number of the vibrating elements 12 is not limited to two. The number may be decided on one or more according to the size and/or the shape of the touch panel (or the flat vibrating body) 11.